1. **Results:** Appropriate equipment has been assembled and literature examined to begin this effort.

2. **Plans:** Isolate CB salivary glands to obtain polytene chromosomes. Attempt to isolate pachytene chromosomes from adult beetles. Use Laser Scanning Microscope to examine larval whole mounts.

3. **Contributors:** T. Burruss, M. Krauss, M. Shulleeta.

4. **References:** Shulleeta, M. PM Notebook No. 9132.

V. Objective: Test feasibility of a method to determine if cured tobacco arose from transgenically modified plants.

A. Strategy: Determine if Polymerase Chain Reaction (PCR) technology can be used to amplify specific sequences of DNA from green and cured tobacco leaf.

1. **Results:** Conditions have been defined for the isolation and subsequent clean–up of DNA from green leaf and cured tobacco material. Specific amplification by PCR of a portion of the PMT gene has been achieved using Burley–21 green leaf, air–cured leaf and flue–cured leaf from the Greenhouse.

2. **Plans:** Optimize conditions for PCR amplification. Examine different types of cured commercial tobaccos.

3. **Conclusions:** Results so far obtained indicate that it is feasible to amplify surviving DNA from cured leaf.

4. **Contributors:** D. Ayers, T. Michalik, M. Shulleeta, G. West.

5. **References:** Ayers, D. PM Notebook No. 9236.

TOBACCO STABILIZATION AND STORAGE

Note: A portion of the activities of the Tobacco Stabilization and Storage Team is reported under Operations Support.

VI. Objective: Develop a better understanding of the CB's response to methoprene.

A. Strategy: Determine the nature (stability, longevity) of the aberrant response of the cigarette beetle (CB) to R,S–methoprene.

1. **Results:** CBs (from Commerce Road Warehouse No. 44) were exposed to R,S–methoprene for a defined number of generations, and then reared on untreated tobacco for a defined number of generations. The response of the progeny was then assessed by subsequent exposure to methoprene–treated tobacco. At least 80% of the larvae exposed to tobacco containing up to 51 ppm methoprene have emerged, and those exposed to tobacco containing 80 ppm are beginning to emerge.

2. **Plans:** Continue to monitor emerging adults from all treated tobaccos. Issue report in Third Quarter, 1993.

3. **Contributors:** D. Coar

4. **References:** Coar, D. PM Notebook No. 9227.

VII. Objective: Identify other potential CB control agents as alternates to methoprene.

A. Strategy: Evaluate the response of the CB to the insect growth regulators hydroprene and kinoprene.

1. **Results:** Adults from both the laboratory colony and a colony derived from feral insects collected at Commerce Road Warehouse No. 44 (previously exposed to methoprene) emerged when exposed to tobacco treated with kinoprene at up to 100 ppm. LD_{50} values could not be estimated.

   Exposure to hydroprene at doses of 0.1 – 100 ppm allowed diminishing emergence of the feral CBs over the entire range of concentrations, with a value of LD_{50} of 6.8 ppm. Laboratory colony CBs manifested a value of LD_{50} of 4.0 ppm. It is likely that concentrations of hydroprene in excess of 100 ppm would be required to attain 100% mortality.

2. **Plans:** No further testing of these compounds is planned.

3. **Conclusions:** Kinoprene does not cause significant mortality of the CB at any concentration tested. Hydroprene causes 50% mortality in a feral colony (previously exposed to methoprene), at 6.8 ppm.

4. **Contributors:** D. Coar.

5. **References:** Coar, D. PM Notebook No. 9112; Coar, D. Bioassay of Hydroprene and Kinoprene. Memo to H. Grubbs, 1993 March 17.

B. Strategy: Implement use on tobacco of the IGR Nylar, for CB control.

1. **Results:** Discussions have been initiated with MGK–Sumitomo, Inc. to obtain registration for use of Nylar, on tobacco . A plan to insure implementation of this goal at the earliest practicable date has been completed.

2. **Plans:** Immediately initiate plan.

3. **Contributors:** D. Coar, D. Faustini, R. McCuen.

4. **References:** None.

TOBACCO STRUCTURE

VIII. Objective: Develop chemical means of enhancing the filling power of blend components through shred stiffening. Where possible, define the chemical mechanisms of stiffening.

A. Strategy: Develop a predictive method for the determination of filling power in the cigarette.

1. **Results:** The centrifugal method for measuring filling power index described by Resnik (1961) was modified to measure the packing density of tobacco in a

cylindrical tube. Unlike the current CV measurement, this technique provides a means to apply a range of forces that compress tobacco to the same density as that found in cigarettes at specified firmness. Preliminary results show that the technique yields expected results when moisture content of filler, sieve size and orientation of shreds are varied.

2. **Plans:** Continue to explore the utility of the centrifugal method of measuring filling power in the cigarette.

3. **Contributors:** G. Chan, M. Krauss.

4. **References:** Krauss, M. PM Notebook No. 9204; Resnik, F. Filling Power, PM Special Report, Accession No. 1457, 1961 December 15.

B. **Strategy:** Investigate the effects of Ca(OH) /sucrose mixtures and other calcium salts on filling power (chemical stiffening).

1. **Results:** Concentrated solutions of CaO/sucrose, Ca(OH) /sucrose, Ca gluconate and Ca diethylacetate have been prepared.

2. **Plans:** Begin add–on experiments to test the effects of these solutions on chemical stiffening.

3. **Contributors:** G. Chan, J. Paine.

4. **References:** Chan, G. PM Notebook No. 8857.

PROGRAM NAME : R&D Product Technologies – Smoke Technology
PROGRAM COORD. : R. Jenkins and D. Leyden
WRITTEN BY : R. A. Comes and P. F. Grantham
PERIOD COVERED : Second Quarter, 1993

I. Objective: Support the development of new products through the measurement and characterization of cigarette smoke and its relationship to cigarette design and consumer acceptance.

A. Strategy: To develop an outline of objectives and strategies focusing on necessary information and resources relating to defined Programs.

1. **Results:** During this period, teams have participated in sessions on "Paradigms", "Meyers–Briggs Type Indicator" and on the new "Performance Management Process". Additional training sessions have been identified. The Database Team issued a survey to all members of PRD relating to needs in data generation, storage and retrieval. This was extended to include a discussion and demonstration by a representative of Galactic Industries on their "Grams/386" software. Contacts in CAD have been identified to assist in the computer purchase decision making process and in the establishment of a PRD database. An "Operational Plan" encompassing those defined areas identified in the "Strategic Plan" was developed and issued. Several Division members participated in the intense effort to develop R&D "Strategic Objectives".

2. **Plans:** Continue development and use of Operational Plans based on established priorities.

3. **Contributors:** Smoke Research Group

B. Strategy: Coordinate efforts to relocate members of Smoke Research.

1. **Results:** Most laboratory instrumentation and all computer capabilities are operational following successful completion of the moves. These moves were complicated by the modifications required to some of the laboratories and by the significant cleanup and chemical and equipment disposition necessary to make the laboratories habitable.

2. **Plans:** Initiate new and proceed with ongoing Smoke Research Group efforts.

3. **Contributors:** Smoke Research Group

C. Strategy: Establish a baseline profile of chemical and physical components related to critical properties of conventional cigarettes. Utilize the 1R4F reference cigarette to determine and/or confirm deliveries of specified components in sidestream and mainstream smoke.

1. **Results:** A list of identified "critical components" was divided among members of the "Conventional Cigarette/Baseline Study Team" to conduct literature searches

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relating to standard methods of analysis and anticipated smoke concentrations. Approaches to the study and the instrumentation needs were discussed. Efforts to date include:

- Mass burn rates for 1R4F, IM13 and IM14 cigarettes were measured under static smoking conditions using the balance method.
- Mainstream and sidestream TPM, tar, nicotine and water deliveries were determined on the 8–port smoking machine.
- 1R4F cigarettes were sent to UVA for neutron radiographic analysis to measure mass burn rate and to determine the buildup of condensible material under static and dynamic smoking conditions. Neutron activation analysis will be carried out to determine most of the inorganic elements in smoke.
- 1R4F and IM13 cigarettes were smoked in the sidestream smoke chamber. Sidestream constituents including aldehydes, nitric oxide, ammonia, CO and CO2 were measured.
- Reassembly and testing of FTIR and GC instrumentation is in progress to assist in the analysis of other identified smoke components. Two 20–port smoking machines are being set up for use in this and other studies.
- Analytical and smoking methods development continues for sidestream aromatic amines.

2. **Plans:** Continue to conduct analyses of the identified compounds of interest in the smoke from 1R4F cigarettes.

3. **Contributors:** Conventional Cigarette/Baseline Team

II. **Objective: Primary Technologies** – Provide necessary fundamental information to maximize the probability of realizing specified cigarette weight reductions.

A. **Strategy:** Examine the effects of unit process changes and cigarette weight reductions on the chemical, physical and subjective characteristics of tobacco and smoke.

1. **Results:** Issued in the Primary Technologies Quarterly Report.

2. **Plans:** Continue to support the efforts as defined in this Objective.

3. **Contributors:** Primary Technologies Team

III. **Objective: Primary Technologies** – Develop casing and flavoring systems that compliment the process developed in this program and achieve the subjective acceptability necessary to produce existing and additional value added products.

A. **Strategy:** To provide expert testing of models from various development stages of the Primary Technologies Program. To establish a sensory basis for qualifying Primary Technologies as a viable alternative to the current primary processing. To support Primary Technologies by providing capabilities for smoke profiling of cigarette fractions.

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1. **Results:** Issued in the Primary Technologies Quarterly Report.

2. **Plans:** Continue to support the efforts as defined in this Objective.

3. **Contributors:** Primary Technologies Team

IV. **Objective: Cast Leaf/NBL** – Utilize the Cast Leaf Pilot Plant to develop new technology applicable to the present RCB process to improve sheet quality without changing the subjective character or delivery.

A. **Strategy:** Develop an analytical method to profile NBL slurry which will reflect subjectively acceptable sheet. Investigate the chemical changes which occur during production of NBL sheet.

1. **Results:** Issued in the Cast Leaf/NBL Quarterly Report.

2. **Plans:** Continue to support the efforts as defined in this Objective

3. **Contributors:** Process Chemistry Team

V. **Objective: Project Tomorrow/Happen** – Support the development of Project Tomorrow/Happen related programs and products.

A. **Strategy:** Utilize various physical and chemical procedures to identify and quantitate parameters important to the development of products.

1. **Results:** Issued in the Tomorrow/Happen Quarterly Report

2. **Plans:** Continue to support the efforts as defined in this Objective.

3. **Contributors:** Tomorrow Team

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PROGRAM NAME : R&D Product Technologies – Sensory Technology
PROGRAM COORD. : R. A. Carchman
WRITTEN BY : F. P. Gullotta AND C. S. Hayes
PERIOD COVERED : Second Quarter, 1993

Coordinator Summary: The Sensory Physiology Laboratory has been reestablished at INBIFO and a preliminary proposal to evaluate the sensory characteristics of minor tobacco alkaloids in cigarette smoke has been prepared. Previously observed differences in the concentration response curves for *(R)*– and *(S)*–nicotine in the frog electro–olfactogram at INBIFO were not confirmed upon retesting with redistilled/purified samples. A patch clamp recording facility has been established in Erlangen. Nine model cigarettes which vary in nicotine delivery were prepared and shipped to INBIFO for sensory evoked potential testing. Sensory Technology "toolbox" issues continue to be reviewed.

I. Objective: To develop the technology to produce low alkaloid and low tar/low alkaloid cigarettes that have sensory characteristics superior to currently available products.

A. Strategy: Develop a fundamental understanding of how nicotine affects sensory systems.

1. **Results:** The difference in the concentration–response curve for *(R)*– and *(S)*–nicotine for the frog electro–olfactogram at concentrations up to 70 g/l seemed to be related to the impurity of commercially obtained *(S)*–nicotine. This difference was not confirmed for nicotine purified by redistillation.

   The Sensory Physiology laboratory has been completed. A preliminary proposal addressing the role of minor tobacco alkaloids in cigarette smoke has been prepared. Nine model cigarettes with a tar delivery of approximately 17 mg/cigarette and ranging in nicotine delivery from 0.12 to 1.56 mg/cigarette have been prepared. Pilot investigations on cognitive event–related potentials to odorants have been successfully conducted in collaboration with the Kobal group. A patch clamp recording facility has been established in Erlangen.

2. **Plans:** Differentiate between olfactory and trigeminal activity in the frog electro–olfactogram (e.g., at different sites and by antagonist treatments). Investigate the role of impurities of nicotine preparations.

   Complete revised proposal on minor alkaloids and submit it to an external ethics committee. Generate a nicotine/evoked potential curve over a range of nicotine levels using the above model cigarettes. For the patch clamp investigations in Erlangen, refine methods and approaches with the goal of understanding mechanisms behind olfactory transduction.

3. **Contributors:** INBIFO, Kobal (Erlangen), Product Research, Flavor Technology

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PROGRAM NAME : R&D Product Technologies – Consumer Research Technology
PROGRAM COORD. : M. A. Jeltema/J. A. Jones
WRITTEN BY : Contributors
PERIOD COVERED : Second Quarter, 1993

Coordinator Summary: Plans are progressing according to schedule.

DOMESTIC

I. Objective: Design and implement programs to study and monitor consumers' concerns/desires. Understand factors affecting smokers' attitudes about smoking. Identify new issues as they arise.

A. Strategy: Determine whether smoke style questions (attitude, behavior, and lifestyle) can be used to determine interest in new concerns/issues and to segment market.

1. **Results:** Research continues to show that attitude is important to predicting consumer interest in product ideas. Preliminary data also indicate that lifestyle and behavior are also important contributors. Additional information was gathered from consumers during concept testing. Results of research to date are being compiled.

2. **Plans:** Preliminary data from the LS/LO study and the concept study will be analyzed to investigate the most useful ways of relating attitude and lifestyle questions. Plans for incorporating attitude/lifestyle variables in future research will be based on those findings.

3. **Contributors:** P. Callaham, J. Gear, M. Jeltema, J. Jones, C. Kuesten

B. Strategy: Identify variables associated with early–stage triers of new products.

1. **Results:** Data from previous research on group leaders and trend setters are being gathered. One questionnaire was used in the concept test to gather some initial information.

2. **Plans:** Research conducted to date will be discussed and future research proposed.

3. **Contributors:** B. Bittner, D. Ennis, M. Jeltema, J. Jones

II. Objective: Generate and explore new ideas which will address consumers' needs and add value to our existing or new products.

A. Strategy: Generate, consumer explore, and refine new product concepts to provide R&D and Marketing with directions for potentially viable consumer driven products; assess the ideation procedure for routine use in PM U.S.A. and International.

1. **Results:** The Concept Ideation Team has been formed. Phase I, brainstorming of core concepts, and Phase II, core concept screening, have been completed.

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2. **Plans:** Phase III, enhancement of selected core concepts and Phase IV, overall and concept component evaluation, are to be scheduled.

3. **Contributors:** P Callaham, J Jones, T. Cutler, P. Gauvin, E. Gee, T. Lynn, M. Mahan, H. Spielberg, J. Spruill, B. Stevens, D. Patton

B. **Strategy:** Determine if new packaging concepts would add value and quality perceptions to existing full–margin brands thus potentially slowing down the switching rates and alternate purchasing from full–margin to price value.

1. **Results:** A large scale consumer research proposal to look at aluminum and plastic materials was presented.

2. **Plans:**

- Conduct large scale consumer research.
- Determine feasibility of making drawn versus folded aluminum versus plastic packaging.
- Conduct an internal usage test on booklet pack.

3. **Contributors:** P. Callaham, J Jones, J. Tindall, R. Newsome, D. Wilder, E. Wooldridge, C, Altizer, P. Gauvin, L. Gregory, C. Hansen, E, Gee

C. **Strategy:** Conduct studies to further the understanding of low sidestream and low odor efficacy and sensory cost/benefit.

1. **Results:** Analysis of lingering odor for the control, low odor, low sidestream, and low odor/low sidestream models showed cigarette model differences were room/material dependent.

2. **Plans:** A research program for lingering odor will be proposed.

3. **Contributors:** C. Kuesten,

D. **Strategy:** Create a communication vehicle between the sales force, R&D, and Marketing which encourages the sales force to listen for and share potential new product concepts and issues.

1. **Results:** None to date.

2. **Plans:**

- Interview Marlboro Adventure Team participants and sales force.
- Design mailer as a vehicle for sales force to communicate with R&D and Marketing.

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III. **Objective:** Develop models to predict consumer behavior and brand choice based on product, market, and demographic variables.

A. **Strategy:** Develop neural network models for switching.

1. **Results:** No results were achieved during the previous quarter.

2. **Plans:** Based on a set of neural network models which have already been developed from 1990–91 Tracking data, analyze a set of problem scenarios specified by PED. Based on 1992–93 Tracking data, develop a set of neural network models to predict brand switching behavior as a function of product attributes as well as demographics and product attributes. Use these models to predict the impact of line extensions, new product concepts, and price reductions, as well as for offensive and defensive direct marketing.

3. **Contributors:** J. Blankinship, M. Johnston

4. **References:** Report 93–003

IV. **Objective:** Develop methods to quantify the cost/benefit relationship between potential benefits and consumers' desires.

A. **Strategy:** Determine the relative importance of known benefits to the consumer and the cost tradeoffs that the consumer would be willing to accept for these benefits.

1. **Results:** Cost/benefit research has been planned. An internal pretest was conducted and data is being gathered from consumers from Miller and Kraft/General Foods..

2. **Plans:** The results from the consumer study will be analyzed and discussed.

3. **Contributors:** D. Ennis, E. Gee, M. Jeltema, J. Jones, A. Manwaring, J. Tindall

B. **Strategy:** Develop methods to determine the relationship between cigarette changes (flavors, construction, etc.) that will involve sensory cost and their impact on marketplace purchase.

1. **Results:** A method has been proposed.

2. **Plans:** The proposal will be reviewed for approval in June.

3. **Contributors:** M. Jeltema, J. Tindall

V. **Objective:** Maintain a knowledge base of the importance to consumers of different product attributes.

A. **Strategy:** Define sensorially a smoker's view of deep discount brands.

1. **Results:** A total of 10 POL tests have been conducted on deep discount brands from the various cigarette companies (Philip Morris, RJR, Brown & Williamson, American Tobacco), to date.

2. **Plans:** The following 7 tests are scheduled for the 85mm and 100mm Nonmenthol Panels:

Full Flavor 85mm Nonmenthol Panel	5 Tests
Flavor Low 100mm Nonmenthol Panel	2 Tests

3. **Contributors:** A. Manwaring, B. Joyner

B. **Strategy:** Obtain consensus on Control Regions for current and future Marlboro testing and change in method.

1. **Results:** The research proposal for the unovertipped single pack testing was developed and reviewed. A working definition of the monitoring procedure has been finalized.

2. **Plans:** More tests of Marlboro controls from the different factories, as well as the unovertipped single pack testing are being conducted and will be reviewed with recommendations.

3. **Contributors:** D. Atkinson, R. Cox, R. Heretick, M. Jeltema, A. Smith, H. Spielberg, J. Tindall, M. White.

C. **Strategy:** Determine whether strength ratings are adequately described by an overall panel ratings and regression based on tar per puff.

1. **Results:** Using global monadic data, a determination of whether differences exist in the way smoker categories (full–flavor, flavor–low, ultra–low) rate strength is underway. The development and evaluation of strength scores by smoker group, tar per puff, and nicotine has not been completed to date. Graphs of strength regressions of nicotine per puff versus tar per puff have been done to determine which criteria should be used to predict strength ratings. Evaluation of these regressions will be conducted during the third quarter.

2. **Plans:** Results from evaluation of all data will be reported collectively.

3. **Contributors:** B. Joyner, J. Tindall

D. **Strategy:** Evaluate effect of repacking mentholated cigarettes on liking/menthol ratings.

1. **Results:** Menthol–per–puff deliveries (before and after overtipping) for production cigarettes and cigarettes made in semi–works with comparable production dates have been reviewed. Plots have been generated to show visually the changes in menthol–per– puff deliveries before and after overtipping (involves repacking for production cigarettes).

2. **Plans:** Menthol–per–puff deliveries will be reviewed in the context of handling procedures to determine whether additional research is needed.

3. **Contributors:** M. Fleming, D. Atkinson, D. Birdsong

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E. **Strategy:** Determine factors affecting degree of liking deficit by changing tipping color.

1. **Results:** Liking ratings for king size flavor low smokers in the nonmenthol category of competitive testing have been reviewed. Marlboro Lights, Winston Lights, and Merit smokers' liking ratings for full margin cigarettes and experimental cigarettes (those used in Virginia Slims Nonmenthol testing) were evaluated to determine an estimate of the liking deficit when the tipping color is changed. The means for the flavor low smokers in the 100mm category have been organized for review.

2. **Plans:** Review 100mm flavor low smokers' liking ratings of cork and white–tipped cigarettes.

   Review liking ratings (cork vs. white) for smokers in the other nonmenthol delivery categories and begin reviewing liking ratings in the menthol categories.

3. **Contributors:** M. Fleming

VI. **Objective:** Continuous improvement of sensory methodologies.

A. **Strategy:** Establish database of POL data as an accessible, usable, and reliable data management tool.

1. **Results:** Work has progressed on the verification and validation of the POL Complete database. A draft of the user's guide which illustrates the screens, examples of SQL language, and specifics programmed to interact with the database is completed. The Sensory Research group is working with the Apt Screens to generate views and studies for current programs and editing Excel spreadsheets . CAD will read this corrected data back into the database.

2. **Plans:** Plans are to complete the POL Complete database verification by the end of September. Functions which feed the database will be verified by checking results against current analysis results. Weekly meetings are being held Friday afternoons to review progress and or problems as they arise. CAD is currently restructuring the database to deliver a more comprehensive and flexible data management tool to PED. SAS Access, Data Pivot ,and Data Prism software will be examined as software tools to expand the ease of access and utility of the database.

3. **Contributors:** M. Fleming, B. Joyner, C. Kuesten, A. Manwaring, F. Scott, A. Smith

B. **Strategy:** Computerize NPP single puff sensory methodology.

1. **Results:** A Hypercard prototype which guides panelists activities' (lighting, machine puffing, and smoking) pairs of cigarettes for same–difference judgments has been built. The program is designed to: 1) provide instructional and timing assistance, 2) maintain panelist attention, and 3) provide feedback on performance. Various formatted output files are generated to facilitate data assimilation and analysis.

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2. **Plans:** Future plans include further refinement of the existing prototype and development of higher level control functions for test design and analysis. Search, selection, and acquisition of hardware and software to implement the system will be pursued.

3. **Contributors:** C. Kuesten, D. Ennis

C. **Strategy:** Evaluate panelists' behavior in POL testing to improve future test and ballot designs as well as help improve our panelist selection process.

1. **Results:** Articles from external literature searches have been reviewed to gain some information on studies related to panelists' behavior in product tests. A review of switchers from recent POL tests has been completed and some hypotheses have been formed regarding panelists' understanding of brand questions and the kinds of switching patterns they exhibit. Some hypotheses have also been formed regarding low returns.

2. **Plans:** The information gained from articles/data sets will be summarized and a proposal will be presented.

3. **Contributors:** M. Fleming, P. Martin, F. West

D. **Strategy:** Implement a cross training program.

1. **Results:** A proposal has been written.

2. **Plans:** The proposal will be reviewed for acceptance.

3. **Contributors:** A. Manwaring, J. Spruill, M. Jeltema, C. Altizer

E. **Strategy:** Evaluate Excel and DeltaGraph to determine whether they meet the technical needs of our group.

1. **Results:** DeltaGraph learning is in progress.

2. **Plans:** Learning of DeltaGraph will be completed by the end of July and Excel by the end of August.

3. **Contributors:** F. Scott

F. **Strategy:** Compare NPP results versus POL results to determine how differences found from NPP single puff methodology compare to consumer test results.

1. **Results:** Background information is being gathered. Meetings were held with D. Ennis and C. Hayes to gather information on the methodology to be proposed in evaluating NPP versus POL panel results.

2. **Plans:** A proposal will be developed and presented on the methodology by June.

3. **Contributors:** B. Joyner, M. Jeltema, D. Ennis, C. Hayes, S. Clark, T. Callaham

VII. Objective: Continuous Improvement of POL Databases.

A. Strategy: Recruit and maintain a panel that is geographically and demographically representative by brand to conduct 60 Marlboro Monadic Studies and 120 Global Monadic Studies.

1. **Results:** During the second quarter, 57 POL Product Tests were mailed and 223,333 Recruitment Applications to potential panelists were mailed.

2. **Plans:** Continue to determine selection criteria for each recruitment mailout based on current panel needs, mail out recruitment letters to potential target panelists, and evaluating methods to improve selection criteria based on switching patterns.

3. **Contributors:** F. West, F. Warner, M. Jeltema, M. Fleming, M. Radzom

B. Strategy: Continuously update POL database with current information on panelists to assure returns of at least 70%. Potential target panelists will be prescreened every two months and mailed either a Brand Update or Repoll Survey. New panelists will be welcomed to the panel with a Brand Update Survey. Panelists not responding to a POL Product Test will be sent a Tracer Letter.

1. **Results:** During the second quarter, 11,653 potential target panelists were mailed a PreScreen Survey, 7,917 new panelists were mailed a Welcome Test, and 18,291 non–responsive panelists were mailed a Tracer Letter.

2. **Plans:** Continue to target potential panelists for a POL Test with a PreScreen, Welcome Letter, Brand Update, Repoll Survey, or Tracer Letter.

3. **Contributors:** F. West, F. Warner

C. Strategy: Streamline access and manipulation of the PED Databases.

1. **Results:** No progress to report to date.

2. **Plans:** 1. Implement interactive link for all PED Databases and to other R&D Databases. 2. Eliminate data entry of generic information shared with PED by other database users outside of PED. 3. Develop and propose plan to emulate current POL Database and POL Complete Database for Internal Panels (Japan, Hong Kong, Korea, Australia).

3. **Contributors:** F. West, M. Radzom, D. Birdsong, J. Jones

D. Strategy: Restructure POL Database.

1. **Results:** The April 1, 1993 deadline was not met for restructure of POL Database due to a delay in testing the new or revised features. The database could not be populated because of limited disc space and problems with the Sybase server. CAD–Phase 1 re–scheduled to be completed by August 1, 1993. This phase still includes new processing editors, full implementation of UPC Codes, expansion of select capabilities to allow more flexibility, and modification of key tables to enhance maintenance capabilities.

2. **Plans:** CAD–Phase 2 project, which includes the evaluation and implementation of end–user database access and analysis tools, is rescheduled to start August 1, 1993.

3. **Contributors:** F. West, C. Kuesten, M. Radzom

INTERNATIONAL

VIII. **Objective:** Investigate international marketplace dynamics and consumer demographics, lifestyles, behavior, attitudes and product perceptions.

A. **Strategy:** Identify forces that impact market share in our International markets.

1. **Results:** Meetings were held with PMI Information System representatives and approval has been given for on–line access to market share data. Share data files have been updated based on our most recent information for Japan, Korea, Hong Kong, Malaysia, Singapore, Taiwan, and the Philippines. European share data were collected for 5 countries in support of a May visit by PED personnel to Neuchatel.

2. **Plans:** CAD is in the process of determining the optimal approach for on–line access to share data, including cost, and time frame considerations. Arrangements have been made to obtain market share data and establish databases for Australia to supplement our support for the new Australian Consumer Panel.

3. **Contributors:** C. Matthews, D. Purvis, CAD.

B. **Strategy:** Conduct/monitor in–depth research to understand consumers' attitudes, lifestyles, behavior, and potential interest in product benefits.

1. **Results:** PED and PM Europe met to discuss methods of investigating European consumers' perceptions of quality. Our Korean panel ballot was modified to include alternate brand purchase questions.

2. **Plans:** Meet with PMKK to discuss insights on the Caster family smokers; determine what additional information is necessary and propose methods for obtaining those data. Conduct a similar review of information on Japanese Frontier Lights smokers, particularly to address their choice process and benefit perceptions important in motivating brand switching. Discuss research proposals with PMKK for quantifying consumers' self–reported brand choice attributions, thereby identifying salient product and packaging benefits. Provide Hong Kong and Korea with support for Slim King Size qualitative research and procedures for assessing smokers' interest in various product benefits, by segment, to give direction for product opportunities.

3. **Contributors:** C. Matthews, D. Purvis, J. Jones

IX. Objective: Evaluate product features for perceived benefits/added value.

A. Strategy: Investigate methods to generate/explore new product ideas; assist in concept/prototype research design.

1. **Results:** Methodologies for concept generation/exploration are under investigation in the U.S., with potential application for PMKK and PM LTD Australia.

2. **Plans:** Product/concept testing procedures are being discussed for use in several Asian programs, such as menthol research in Hong Kong and Japan, and Slim King Size research in Korea.

3. **Contributors:** J. Jones, C. Matthews, J. Smith

B. Strategy: Obtain and evaluate consumer information relating to the product benefit themes of social acceptability and packaging.

1. **Results:** In meetings with PM Europe and PM Australia, we reviewed methods and results from domestic research on topics of low smoke/low odor, new packaging, and selected case studies.

2. **Plans:** Meet with PMKK to propose a low smoke/low odor research program in Japan to assess product opportunities. Propose focus group research and new packaging qualitative research in Japan to assess attributes viewed as potential benefits.

3. **Contributors:** J. Jones, C. Matthews, J. Smith, PMKK

X. Objective: Insure the validity, reliability, and effectiveness of PM–International's subjective testing program through theoretical and applied methodological research.

A. Strategy: Evaluate and implement improvements in Asian panel data collection methods.

1. **Results:** The performance of the newly established Malaysian Consumer Panel and Australian Consumer panel (each with two tests, eight products) have been evaluated. Results demonstrate effective use of scaling and show the sensory relationships of marketplace brands. Data were presented and interpretations discussed with Asian management and research groups. Monadic procedures implemented in Europe were reviewed; work sessions were held in the region for test design, scaling, analysis procedures, and interpretations of results.

2. **Plans:** Assess nonsensory product features that may influence sensory ratings in Malaysia and Australia. Evaluate the data from each Asian consumer panel to determine the effect of procedural design parameters, with product construction/analytical factors, on sensory response.

3. **Contributors:** C. Matthews, M. Ferro, J. Jones, D. Purvis, J. Smith, R. Slagle, PM Asia

B. **Strategy:** Manage databases to improve efficiency of analysis.

1. **Results:** Data analysis by chi–square is being applied to Japan consumer panel data. The monitoring of marketplace brand changes and control databases continues on an ongoing basis.

2. **Plans:** Chi–square analyses will be implemented for use on each of the consumer panels.

3. **Contributors:** C. Matthews, D. Purvis, M. Ferro, J. Tindall

C. **Strategy:** Improve data presentation effectiveness.

1. **Results:** For each consumer panel and smoker group, the capability to plot own brand ellipses relative to major competitors and relative to brand family extensions is maintained on an ongoing basis.

2. **Plans:** Implement technology transfer of analysis methodologies to PMKK and PM Asia. Present project summaries by means of on–line computer projections.

3. **Contributors:** C. Matthews, D. Purvis, M. Ferro, CAD

XI. **Objective:** Maintain external consumer panels to conduct sensory research.

A. **Strategy:** Assure the international regions, the sensory research vendors and R&D concur on research expectations.

1. **Results:** Pure monadic research procedures were proposed for future Korean 100mm and menthol programs. Logistics of these procedures were discussed with our Korean research vendor, who is submitting cost estimates.

2. **Plans:** Visit current contract research houses to review all panel issues. On an ongoing basis and in conjunction with the regions, identify research programs which require supplementing our panel compositions, and communicate requests and timetables to vendors.

3. **Contributors:** C. Matthews, J. Jones, M. Ferro, D. Purvis, Export PD, PMKK, PM Asia, ASI, Hankook, MDR, Consumer Probe

PROGRAM NAME : New Primary Technology
PROGRAM COORD. : S. E. Clark
WRITTEN BY : D. R. Fox
PERIOD COVERED : Second Quarter, 1993

Coordinator Summary: The BRICA Cost Reduction team recommended implementing Hauni steam tunnels for Louisville to reduce the costs of BRICA–based discount brands. The recommendation has been approved, and installation of the first tunnel will be completed for a January 1994 startup, with installation of a second tunnel to follow after qualification of the first tunnel. The team also conducted preliminary tests on the effect of ET inclusion into BRICA products.

Development of the Individual Component Processing scenario continued on schedule during the past quarter. This scenario involves DCC conditioning, preblend casing in the DCC, low moisture strip heating prior to cutting, "split–casing" of burley, tunnel treatment, and filler blending. Major tests to demonstrate the concept on the large–scale Semiworks system are now in progress.

A portion of the Process Engineering group from Engineering transferred into R&D Process Development during the quarter, joining the NPT group. This group will continue to support the NPT program by developing filler dicing and a non–pneumatic maker feed system.

I. Objective: Develop a process for preparing blend components individually or in selected combinations which manages the interactive objectives of maximizing the cigarettes produced per pound of tobacco utilized and achieving subjective acceptability of the blend.

A. Strategy: Utilizing various blending techniques, demonstrate that components produced with Individual Component Processing (ICP) can be blended to a degree of uniformity that is at least comparable to current total blend process methods.

1. Results: Development continued on an analytical tool to perform blend analysis on a single cigarette rod as a measurement of blend uniformity. Analysis of Marlboro samples indicated that the use of X–Ray Fluorescence (XRF) data improved the precision of the analysis. The study also indicated that using XRF intensities rather than absolute elemental concentrations resulted in lower standard errors. While the differences between models were smaller using intensities, this method is preferred as it eliminates the need to calibrate the X–ray spectrometer.

The plan for the development of the blend analysis system using BRICA blend components was completed. The first grinding of the calibration mixtures and the set of "pseudo" unknowns were analyzed by XRF and NIR/Mid IR FT for generating blend prediction models. Model generation using the calibration set is in progress.

Based on picking results from ripped cigarettes, there were no statistically significant differences in the blend uniformity of ICP filler mixed with the in–line blending device, ICP filler with silo blending in a silo, and filler made from the conventional total blend process. Of the two ICP alternatives, the blending device resulted in shorter filler than silo blending (58% vs. 65% over 12 mesh) but showed

comparable shred size in the final cigarettes (both with 42% over 12 mesh). Cigarette firmness for the two models was comparable.

Picking results also showed that the uniformity of finished filler blended into the six–position PM80 box station was at least as uniform as that obtained from silo blending.

Replacement of the mechanical distributor on the in–line blending unit with air knives is being investigated as a means of reducing filler degradation. A prototype system has been installed and is now being evaluated.

2. **Plans:** The analysis of the XRF and NIR/Mid IR FT data for BRICA components will be completed, and an automated procedure for obtaining IR spectra and integrating it with the XRF spectra will be developed for individual cigarettes. This method and other analytical techniques will be used to confirm the uniformity results from picking for the blending process alternatives. The air knife system will be evaluated and refined if results are promising.

3. **Conclusions:** Either in–line blending or silo blending of ICP filler results in a finished filler as uniform as that obtained with total blend processing. Blending finished filler directly into PM80 boxes provides blend uniformity comparable to that obtained with silo blending of finished filler.

4. **Contributors:** C. Harward, P. Kurth, B. Martin, R. Mullins

5. **References:** C. Harward, "Blend Composition Analysis Program Modification", April 6, 1993.

B. **Strategy:** Determine the unit operation configuration for Individual Component Processing to optimize cut component physical quality and performance. Identify, by component, specific operational parameters for each operation that provide improved strand length and cigarette firmness.

1. **Results:** An initial POL to qualify the Semiworks DCC for all blend components fell in the reject region. Since Cabarrus had successfully qualified their DCC system for lamina components, attention was concentrated on the recon components. A second POL using only lamina components was very close to acceptability but a repeat of the POL was indicated. Evaluation of 100% recon models is in progress, with initial indications that RCB may be the source of the problem.

   A number of tests were run to optimize processing conditions for individual tobacco components. These tests all employed the standard NPT treatment: conditioned strip is heated prior to cutting (using either a Panda steaming tunnel or KGF microwave unit), cut at a relatively low OV (about 18%), and then treated to enhance the filling power (using either a steaming tunnel or microwave) prior to drying.

   A comparison of the two strip heating methods showed that Panda treatment with superheated steam yielded better shred size out of the cutter than microwave treatment. Panel smoking showed similar subjective attributes for both methods.

The Panda treatment of strip was then used for a test comparing the filling power enhancement alternatives. Of the three, only Hauni tunnel treatment (which uses saturated steam) showed a weight reduction compared to the control. Panda treatment (which uses superheated steam) and microwave treatment showed no effect. In the current Semiworks configuration, however, only the Hauni tunnel is "close–coupled" to the dryer. Treatment with the Panda or microwave requires boxing out and transporting to the dryer, during which the temperature drops close to ambient. This may be responsible for the negative results for these treatments.

Tests were completed with RLB and RLT to determine the optimum operating conditions for maximum filling value. This completed the tests for all of the blend components. All of these tests showed that Hauni tunnel treatment yielded the greatest effect on filling power, with CV increases of 0.1 cc/g for bright and RLB, 0.2 cc/g for oriental, 0.3 cc/g for RCB and RLT, and 0.4 cc/g for burley. Filling power increases were not significantly affected by tunnel residence time, bed depth, or steam:tobacco ratio.

A computer model was developed based on existing experimental data and a theoretical analysis of the Hauni tunnel. Temperature and OV profiles predicted from the model agreed reasonably well with data taken for burley and bright tobaccos at various tunnel operating conditions.

An electric superheater is now being installed on the Hauni tunnel so that steaming with superheated steam, similar to the Panda, can be evaluated in a "close–coupled" configuration with the dryer.

Small scale laboratory experiments were conducted to evaluate microwave treatment of BBOSL and BRICA components wetted to 20% OV. All materials showed a CV enhancement except the sheet materials. The enhancements were about 20% for BBOSL and 12% for lamina components and tended to be directly proportional to the total energy input. Microwave treatment of BBOSL was tested on a larger scale in Semiworks using the KGF microwave unit with a 12% increase in filling power seen. The microwaved BBOSL was incorporated in BRICA blends at 12%, 15%, and 20% inclusion levels. Results from this test are pending.

New control instrumentation and a new operating scheme were designed to enable the KLK dryer in Semiworks to additionally function as a trim dryer for lower moisture removal rates in accordance with the NPT scenario. The new instrumentation is now being installed. Testing with the dryer showed that minimizing the air flow to 50 cfm during drying resulted in the best filling power enhancement through the dryer.

A quote was received from Hauni for a rotary dryer designed for the lower trim drying water removal rates. Additional quotes, including one for a fluidized bed dryer from Proctor & Schwartz, have been solicited.

2. **Plans:** The information gained from the component optimization tests will be used in several ICP tests using BRICA blends scheduled during the next quarter, the first of which will be completed in early June. These tests will compare the ICP process with conventional total blend processing.

The use of superheated steam on the Hauni tunnel will be evaluated for filling power enhancement.

The Hauni tunnel model will be improved and enhanced including all tobacco components and the use of superheated steam.

Additional small scale microwave tests will be performed with burley and BBOSL to clarify the contribution of wetting these materials prior to heating to CV enhancement.

The new trim drying instrumentation will be tested and operating procedures developed for the Semiworks system.

3. **Contributors:** P. Aument, P. Chen, J. Crump, D. Golob, J. Nepomuceno, P. Oglesby, M. Subbiah, M. Toerne

4. **References:** Chen, P., "Computer Model for Hauni Tunnel", March 26, 1993.

C. **Strategy:** Determine the optimum cut component geometry and utilization scenario to maximize filler performance in the cigarette. Develop improved maker feed systems as needed to insure that the improvement from Individual Component Processing are carried through to the maker and cigarette.

1. **Results:** Evaluations of wider cut widths (25 cpi) for several blend configurations have shown inconclusive results. A test plan has been submitted to Semiworks to evaluate the effect of cut width for bright, burley, and oriental in a BRICA blend configuration. This test will also evaluate the impact of individual wide–cut (15 cpi) components as would be possible with ICP processing.

   Four dicing units were purchased and will be installed in June in the Semiworks. Previous tests conducted by Engineering showed that significant tobacco weight reductions were possible using tobacco diced to 1/16 to 1/4 inch shapes at a 25% inclusion level.

   A maker feed prototype system has been assembled at York Engineering to compare pneumatic and non–pneumatic feeding. The system consists of a Cardwell RotaDrum pneumatic feeder system and a pin feeder and vibrating conveyor system to feed a Protos maker. The system is now being checked out electrically and mechanically.

2. **Plans:** Cut width studies will continue in order to conclusively demonstrate the impact of wider cutting in ICP and BRICA–based models.

   The dicing system will be evaluated to determine the best equipment configuration for producing a diced product with maximum yield. Tests will then begin on the effect of diced product inclusion on physical and subjective properties.

   Once checkout is complete, the maker feed system at York Engineering will be used to evaluate the effect of a non–pneumatic feed system on tobacco yields and cigarette properties.

3. **Contributors:** B. Arents, D. Golob, D. Lisbon, W. Mateyka, R. Mullins

D. **Strategy:** Conduct laboratory analyses directed toward identifying and obtaining a better understanding of the mechanisms which influence filling power.

1. **Results:** A model was developed based on laboratory data of the time–dependent CV and relaxation for BRICA bright and burley tobaccos. The model uses a three–element spring–dashpot and two additional Maxwell units, and suggests that there are at least three different processes involved. Bright and burley fillers recovered only about 30% once the load was removed, and the time constants indicated that burley filler is more elastic than bright, which is consistent with earlier stress–strain data.

2. **Plans:** The time–dependent firmness of cigarettes made with bright filler will be determined to see if they correlate with the model. If a correlation is developed between CV and firmness, then other components will be tested to determine their behavior, and the effect of different loads will be determined.

3. **Contributors:** A. Basak, S. Ganeriwala

E. **Strategy:** Develop a database to record processing parameters and to provide access to analytical data for Primary Technology samples.

1. **Results:** A system was implemented to transfer processing parameters from the Semiworks control system to the mainframes in RS/1 format. Analytical data from the Physical Measurements Laboratory (PML) in CTSD is not yet available, as the laboratory has not been interfaced to the database system.

2. **Plans:** The PML lab will be interfaced to the mainframes and the database set up to allow access to the data.

3. **Contributors:** N. Latif, A.. Lewis, R. Mullins

II. **Objective:** Develop casing and flavor systems that complement the process developed in the Primary Technology program and achieve subjective acceptability necessary to produce existing and additional value added products.

A. **Strategy:** Develop flavor systems to achieve subjective targets with individual cut component (ICP) processing. Formulate flavor systems to reduce costs and reduce thermal treatment of flavored tobaccos through consolidation of Unit Operations. Consolidate flavor formulations to reduce cut component storage volume requirements.

1. **Results:** Subjective parity was demonstrated between Marlboro models produced in Semiworks small scale using total blend processing and Individual Component Processing. A similar comparison will be made on the large scale system with BRICA cigarettes produced during the ICP test in early June. The Flavor Technology Panel also found no significant differences in subjective response with a reallocation of a portion of the burley top casing into the aftercut.

   The application of preblend casing in the Direct Cylinder Conditioner was demonstrated and has shown equal casing uniformity and retention compared to conventional treatment. Subjective testing is in progress.

Tests of the burley "split–casing" concept showed no problems with tobacco handling or casing falling off during drying. The "split–casing" process eliminates the intermediate P&S strip drying by applying a portion of the burley casing in the DCC prior to cutting and the remainder to cut burley rag in a standard flavor application cylinder. A standard rotary dryer is then used to dry the burley rag.

Cigarettes were also made for subjective evaluation replacing PG in the preblend casings with either glycerin or water to reduce downstream VOC emissions. Physical and subjective testing is in progress.

2. **Plans:** The ICP test in late May/early June will use DCC casing, "split–casing" for burley, and burley top casing in the aftercut. Individual qualification efforts for each concept will continue.

3. **Conclusions:** The key elements of the NPT casing strategy – casing in the DCC, "split–casing" of burley, and reallocating burley top casing to aftercut – are all operationally feasible and result in no loss of casing uniformity. Subjective acceptance remains as the final criteria for success.

4. **Contributors:** W. Bell, D. Golob, R. Pitts, D. Rockwell, J. Sherron

B. **Strategy:** Provide expert and consumer testing of cigarette models resulting from the development of the Primary Technology Program at various stages in its development. Establish the sensory basis for qualifying the process as a viable alternative to the current primary process and to develop an understanding of the effect of unit operation variables on cigarette sensory parameters.

1. **Results:** Single–puff analysis of 100% bright, burley, and oriental ICP models for various Hauni tunnel conditions was completed. No systematic trends were seen, and bright and oriental showed no significant differences in subjective response. Burley was approaching significance, and preliminary RCB results also show it to be more affected by processing conditions.

   A working group was established from Product Research and Process Development to study the effect of reduced tobacco weight on cigarette subjectives. This program is the result of previous efforts that have encountered unexplained subjective differences with low–weight cigarettes and concern that the NPT goal of reducing tobacco weights may encounter similar problems. The BRICA ICP test in late May/early June is being used as an opportunity to begin systematic studies of the chemical, physical, and subjective effects of processed tobaccos and reduced–weight cigarettes.

2. **Plans:** The smoking panel work with the single puff procedure will be focused on Cambridge and Basic cigarettes made with the NPT toolbox technologies. Descriptive methodologies employing specific attributes will be incorporated into the testing.

   Samples from the BRICA ICP test will be analyzed to identify chemical differences that correlate directly with subjectives. The mass burn rates, mainstream and sidestream TPM deliveries, smoke temperatures, and subjective response of reduced–weight cigarettes will be compared.

3. **Contributors:** G. Chan, D. Ennis, C. Hayes, F. Hsu, R. Kaiser, M. Krauss, B. Joyner, G. McLaughlin, D. McRae, R. Southwick

III. Objective: Develop processing scenarios that maximize productivity, efficiency, and flexibility.

A. Strategy: Develop computer simulation models of New Primary technologies which can be used to optimize logistics of existing operations.

1. **Results:** Development of an integrated model of the existing Cabarrus facility was completed. The model includes primary processing, cut filler basement storage and cigarette manufacturing. Validation of the model against actual production is in progress and has shown good accountability in primary. However, filler inventory imbalances between the cut filler storage and cigarette manufacturing areas need to be resolved.

2. **Plans:** The validation of the existing Cabarrus model will be completed. A "fluid" model of a new primary will be developed to demonstrate improvements against the existing primary model in efficiency and flexibility.

3. **Contributor:** L. Haws

IV. Objective: Identify and recommend technologies which evolve out of the Primary Technology Program for total blend processing that could be implemented within existing facilities to achieve improved tobacco quality and yield and result in reduced cost per thousand cigarettes produced.

A. Strategy: With initial emphasis on discount products, develop new processes and product specifications to improve the tobacco weight versus firmness relationship with acceptable subjective response.

1. **Results:** The installation of two steam tunnels was approved for Louisville with installation scheduled for December, 1993, and startup and qualification to begin in January, 1994. The tunnels will be used initially for Famous Value Brands, all of which will be allocated to Louisville, and Basic menthol will be added later. Together these brands represent an annual production of 19.6 billion cigarettes. At the targeted 25 mg tobacco weight decrease, the tunnels will provide a savings of $0.13/1000 cigarettes, or an annual savings of $2.1 million. The estimated installation costs are $2.0 million capital and $0.2 million expense.

   The decision to implement the tunnels is based on process testing showing a 25 mg. weight reduction at equal firmness for the BRICA–4 blend, plus subjective approval of Bristol models produced in Semiworks using the Hauni tunnel with up to a 35 mg weight decrease. A POL test was conducted on Bristol KS incorporating steam tunnel treated filler. This is the same construction as will be used upon implementation of the tunnels in Louisville. The results indicated acceptability by all smoker groups tested.

   Specifications for the tunnels were supplied to Engineering as a basis for obtaining quotations. After reviewing the quotations, R&D recommended that Hauni be

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selected. Hauni is the only manufacturer with previous experience with tunnels of this size treating cut filler, and all testing was carried out with the Hauni tunnel in Semiworks. Manufacturing Engineering in Louisville will handle the installation, and they have agreed with this recommendation and are preparing to place the order.

Product testing of Basic cigarettes incorporating steam tunnel treated filler has indicated that no construction modifications are required for a 25 mg weight reduction. However, a cigarette paper permeability change from 33cu to 27cu is required for weight reductions up to 35 mg in order to maintain delivery parity.

Product testing of Cambridge continued with emphasis on qualifying the lower cost BRICA–4 blend used for Bristol, Basic, and FVB's. Four POL tests (2 controls and 2 tests) are in progress and final results are expected by early July.

Several tests were completed evaluating the inclusion of expanded BRICA tobacco into the BRICA blend. The most recent test used tobacco expanded at 575F and 675F at inclusion levels of 5%, 10%, and 15%. Because burley tobacco produces unfavorable subjectives at high expansion temperatures, it was excluded from the blend expanded at the high temperature. The unexpanded portion of the blend was prepared with and without Hauni tunnel treatment to evaluate the synergy between ET inclusion and Hauni treatment.

The results of this test showed comparable weight savings for both the 575 and 675 expanded tobaccos with a tendency for subjective preference of the 675° model. Weight savings of 10 mg and 26 mg for 10% and 15% inclusion and no Hauni treatment were obtained at constant firmness. The weight savings increased with Hauni treatment by 15–25 mg. While the weight reductions were slightly less than expected, the comparable subjectives were very encouraging.

For the high ET inclusion models, an experimental 33cu 100% Woodpulp paper treated with 0.6% MAP was used. This paper delivered 2 mg/cigt higher tar deliveries than predicted by the cigarette design computer model. All other weight reductions and cigarette designs were as anticipated. Future models will evaluate the normal 27 cu 0.6% citrate paper as well as the 33cu 0.6% MAP paper.

An analysis of available ET capacity resulted in a feasible scenario with 7% inclusion in all BRICA–based products. As a result, a confirmation test was run with 5% and 10% inclusion of 675 ET for Basic and Cambridge with 10 and 20 mg weight reductions without Hauni treatment of the unexpanded portion of the blend. These models are awaiting subjective and physical evaluation prior to further recommendations.

2. **Plans:** R&D will continue to support the steam tunnel project in Louisville by assisting in the 650 preparation and the layout and startup of the tunnels. Development work on Cambridge products using the steaming tunnel is now starting.

   The results from the ET inclusion confirmation test will be evaluated, and a recommendation will be made for POL testing of the appropriate model.

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3. **Conclusions:** The benefits of Hauni tunnel treatment have been successfully demonstrated, and this technology will be implemented in Louisville. The inclusion of ET has also shown weight reduction potential in price–value products.

4. **Contributors:** B. Bell, M. Buchanan, T. Callaham, R. Keatts, D. Lisbon, R. Mullins, P. Oglesby, D. Rockwell, M. Toerne, C. Wood

PROGRAM NAME : Cast Leaf
PROGRAM COORD. : G. Gellatly
WRITTEN BY : G. Gellatly
PERIOD COVERED : Second Quarter, 1993

Coordinator Summary: Confirmation of the subjective parity of production NBL with RCB by the Richmond Panel is expected in June. Factory NBL with reduced formulation ammonia has been produced to hone in on the dryer profile required to achieve subjective parity. The reduced formulation ammonia will provide a 33% reduction in ammonia emissions at the BL Plant.

Cast Leaf has been made in the pilot plant to the same quality as NBL using a casting box which was shown to be superior to a reverse roll coater for Cast Leaf processing.

An evaluation of a Cast Leaf Facility for International indicated that it was financially attractive with an ROI contingent upon the utilization of Cast Leaf. A low cost plant has been designed in R&D which shows that a 10–15 million lbs/yr plant could be installed for $10 to $15 million excluding building, environmental equipment and utilities.

I. **Objective:** Optimize the current RCB process for improved sheet physical properties, production capacity, and environmental goals.

A. **Strategy:** Utilize the Cast Leaf Pilot Plant to develop new technology applicable to the present RCB process to improve sheet quality without changing the subjective character or delivery.

1. **Results:** No NBL trials, with normal or reduced ammonia, were run in the Cast Leaf pilot plant this quarter because subjective parity with RCBT was sufficiently close to warrant fine tuning of process conditions in the BL Plant.

2. **Plans:** Evaluate NBL in the pilot plant using a casting box which has been found to be very advantageous compared to a reverse roll coater for Cast Leaf development.

B. **Strategy:** Develop a recommendation for the BL Plant modernization.

1. **Results:** Several of the NBL products made in the BL Plant in January were judged by the Flavor Technology Panel to have subjective parity with RCB in a Marlboro blend. The same production dust blend (normal grind 95% < 60 mesh) was used for the test and control products. Hammermilled burley stems were used for the control RCB and burley stems ground to 95% < 120 mesh was used for the NBL. All three production lines were used for the trials over a period of eight hours at line speeds of 350 fpm to 390 fpm and sheet weights of 11.4 g/ft^2 to 13 gm/ft^2. Another BL Plant trial was run on April 8, using the same conditions which confirmed the subjective parity of NBL and RCB, and demonstrated NBL product with reduced ammonia (–33%) to be close in subjective parity with RCBT. Selected models will be subjectively evaluated by the Richmond Panel in May. The tensile strength of all the January and April NBL products was double that of RCB. This increased tensile strength was achieved by the improved uniformity of

the NBL product and the reduced tobacco particle size allowing the reverse roll coater roll gaps to be reduced and the roll speeds increased to increase the slurry shear rate. This could not have been done with hammermilled burley stems because the larger particles would have caused "draggers" under these roll coater conditions.

2. **Plans:** Run a BL Plant trial on May 27 to refine process conditions to achieve subjective parity of reduced ammonia NBL with RCBT and to define the reduced ammonia emissions.

3. **Conclusions:**

   NBL has achieved subjective parity with RCB and has double the physical strength at increased line speed.

   The drying model used in the BL Plant trials reduces the number of trials necessary to achieve our objectives.

4. **Contributors:** Reconstituted Tobacco Development, BL Plant, PM USA Engineering, Physical Research, and Flavor Technology

5. **References:**

   G. Chan, "Technical Seminar – Pectin Release in RCB/NBL Processes," April 21, 1993.

   M. G. McFadden and M. L. Parker, "Effects of Roll Coater Set Points on NBL Sheet Physical Properties," Special Report, May 24, 1993.

   P. Chen, "Process Modeling for Drying BL/NBL," memo to G. Gellatly and T. Holland, April 16, 1992.

   P. Chen, "BL/NBL Drying Model," Special Report, June 1993.

   M. L. Parker and P. Lieberman, "NBL Factory Trial Support – NBL Viscosities – 60 Mesh Production Dust with 120 Mesh Stems and 120 Mesh Production Dust with 120 Mesh Stems," memo to G. Gellatly, January 12, 1993.

   B. Hoskin, "NBL Blend Off," memo to L. Murphy, March 16, 1993.

   M. L. Parker, "NBL Factory Trial Test Plan for April 8, 1993," memo to L. Murphy, April 2, 1993.

   B. Hoskin, "Subjective Results from the January NBL Trial," memo to M. Parker, April 1, 1993.

   M. L. Parker and B. Hoskin, "January NBL Factory Trial Results," Special Report, May 24, 1993.

II. **Objective:** Develop a Cast Leaf process that will provide flexibility in meeting world wide capacity needs for individual reconstituted tobacco types.

A. **Strategy:** Develop a Cast Leaf product with the burn characteristics of RL.

1. **Results:** The quantity of guar gum required to form a sheet of the same quality as RCB was shown to be dependent on the quantity of burley stems in the blend.

Production dust alone required only 3.5% guar gum whereas the normal blend containing 33% burley stems required 7% guar gum.

Future Cast Leaf development will use a standard formulation (PD 67%, BUS 33%, guar 6.2%, PG 2.0%, G 2.0%, 3.0% Isosweet, KS 0.2%) to reduce the variables to be evaluated and will concentrate on improving sheet quality and increasing production rate. The CL product target was set to have a tensile strength and production rate greater than RCB (16 kg/m tensile strength) and a burn rate and tar delivery like RL (100% cigt RL puff count is 6–8 and has 18 mg tar/gm tobacco; 100% cigt RCB puff count is 13 and has 23 mg tar/gum tobacco).

A casting box was designed and installed on the casting belt in lieu of the reverse roll coater after it was observed that the guar gum/tobacco slurry did not respond to shear in the same way as NBL to improve sheet quality. Slurry casting was seen immediately to be smoother with a resulting dramatic increase in tensile strength approaching that of NBL at the same production rate. The puff count and tar delivery of 100% CL cigarettes was 8 puffs/cigt and 15 mg/gm tobacco.

A study of the effect of drying rate and CL tensile strength showed that this could be doubled by reducing the drying rate close to that of a steam dryer. The increased sheet quality was achieved, however, at the cost of a 60% decrease in production rate.

All non–guar gum Cast Leaf product development (i.e. alternate methods of pectin release and steam pressure treatment) have been suspended until the guar gum product is fully developed.

2. **Plans:**

   Determine the packout characteristics of Cast Leaf over a range of OV.

   Determine the survivability of Cast Leaf through cigarette making.

   Evaluate slurry recycling through a refiner, ARDE Barinco and a Colloid Mill on Cast Leaf Sheet quality.

3. **Conclusions:**

   Cast Leaf can be made to the same quality as NBL (i.e.) double the strength of production RCB.

   The inclusion of burley stems in the blend is detrimental to sheet quality.

4. **Contributors:** Reconstituted Tobacco Development and Development Engineering

5. **References:** G. D. Keritsis, "Cast Leaf – 2nd Quarterly Report 1993," memo to G. Gellatly, May 10, 1993.

B. **Strategy:** Design a low cost facility to produce Cast Leaf.

1. **Results:** Process flow diagrams were prepared and equipment selected and sized for a Cast Leaf facility capable of producing 10 and 15 million pounds per year. Preliminary quotations have been received for the identified process equipment to

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establish preliminary cost estimates. The major costs were identified to be the dryer, grinder and design/installation costs. The feasibility of partnering with a vendor, potentially Frigoscandia, as a means of significantly reducing the design and installation costs is being pursued. The current order of magnitude cost for an installed Cast Leaf process (excluding building, environmental equipment, utilities) ranges from $10 to $15 million for a 10 million pound per year facility.

2. **Plans:**

   Complete Process and Instrumentation drawings in June for a low cost Cast Leaf process based on our present knowledge.

   Continue to evaluate equipment for potential plant cost reduction. These include dry foreign material separations from feedstock and a comparison of a Vertimixer and ribbon blender for satisfactory dry blending, and slurry homogenization equipment in June.

3. **Contributors:** Reconstituted Tobacco Development and Development Engineering

4. **References:**

   Simons Eastern, "Proposal for Engineering Services for a Cast Leaf Process," proposal to L. Lipscomb, April 1993.

   Frigoscandia, "Proposal for Engineering Services and Installation of a Cast Leaf Process," proposal to L. Lipscomb, May 1993.

   P. D. Lieberman, "Monthly Report," memo to W. Nichols, May 26, 1993.

C. **Strategy:** Develop a business plan analysis for Cast Leaf utilization.

1. **Results:** The evaluation of the economic feasibility of a Cast Leaf facility for international application was begun. An analysis was completed based upon PM USA economic assumptions on operating costs, depreciation, tax rates, etc. The preliminary analysis indicates that a Cast Leaf facility is financially attractive with the actual ROI contingent upon the utilization strategy of Cast Leaf and local operating costs.

2. **Plans:**

   Complete the economic evaluation of a Cast Leaf facility for international application.

   Prepare an order of magnitude capital cost estimate for Cast Leaf facility in the 3rd Quarter 1993 based on US costs.

3. **Contributors:** Reconstituted Tobacco Development, Applied Technology, PME, Leaf Department

PROGRAM NAME : New Expanded Tobacco
PROGRAM COORD. : E. B. Fischer
PERIOD COVERED : Second Quarter, 1993

Coordinator Summary: Support for the Batch NET Process, both Domestic and International, will continue as requested. The major effort, design and construction of a Short Cycle Impregnation Process for International applications is expected to slow down due to funding restrictions. If funding is approved in the Second Revised Budget, then design will be completed during 1993, followed by anticipated capital funding and construction in 1994.

I. **Objective:** Determine a Tower System Design which will Ensure Successful Scale–Up of the NET Process.

A. **Strategy:** Develop a tower feed valve and separator which will provide maximum product expansion, uniformity, and subjective acceptability.

1. **Results:** A modified cold feed valve was installed on the obloid tower and is presently in routine use. The full width valve is close coupled to the tower, with a chilled water cooling block successfully providing a thermal barrier between the hot tower and the cold valve. The full width feed valve is fed by a cold vibrating conveyor. Tobacco is blown into the tower from the valve using the carbon dioxide air knife previously demonstrated on the round tower. Good expansion has been obtained with this arrangement, demonstrating heat pickup by the tobacco infeed is sufficiently low to prevent degassing, and good mixing is being obtained at the critical initial contact point, below the valve, between the impregnated tobacco and hot tower gas. Testing demonstrated the need for the carbon dioxide air knife, although carbon dioxide flow has been reduced to the minimum range on the present flow meter.

   Various modifications were unable to eliminate product recycle in the pilot separator sized to easily fit into the Bermuda installation.

2. **Plans:** Install a reduced range carbon dioxide flow meter and test further reductions in carbon dioxide gas flow in the cold feed valve by June 1993. Continue work to obtain separator improvements.

3. **Conclusions:** With the exception of carbon dioxide flow through the air knife, operating parameters for the cold feed valve have been established.

4. **Contributors:** T. Clarke, A. Kumar, R. Lum, R. Prasad, J. Washington, W. Winterson

B. **Strategy:** Determine the tower design and operating ranges which will ensure successful scale–up of the NET process.

1. **Results:** A full evaluation of the obloid tower was completed using DIET impregnated BLDET. These tests demonstrated the pilot obloid tower eliminates

the previously demonstrated decline in CV with increasing throughput in round towers. This result is attributed to improved dispersion of tobacco in the tower gas, which was independently confirmed using thermocouples throughout the tower. This good dispersion was obtained even at a low tower velocity, which was shown previously to improve particle size by reducing degradation.

2. **Plans:** Confirm obloid tower performance on NET at high throughput by July 1993.

3. **Conclusions:** The obloid tower eliminates the negative effect on expansion of tobacco throughput previously demonstrated on the pilot and commercial towers. Implementation of an obloid design on a tower operating at 5000 lbs/hr throughput is expected to provide improved expansion, approximately 0.5 CV units, and improved particle size by enabling operation at reduced velocity. The obloid tower would require a tower temperature increase of approximately 25°F.

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II. Objective: Provide Product Support to Leaf for NET Inclusion in Full Margin Brands.

A. Strategy:

1. **Results:** We have positive internal results for all brands that are scheduled to receive NET:

BRAND	% NET
B&H 100's	15
B&H Ultra Lights	22
Virginia Slims	15
Virginia Slims Lights	15
Virginia Slims Ultra Lights	22
Parliament	15
Saratoga (Not Made)	15
Merit	15
Merit Ultra Lights	25

In addition, positive results have been achieved in the following POL's:
B&H 100's – POL 05029
B&H 100's – POL 05069 (Rep. 2)
Merit 85 SP – POL 02092
Merit 85 SP – POL 02126 (Rep. 2)
Merit UL – POL 02127

Also, three POL's were run on the new Merit Super Lights prototype (3 mg tar, 38% NET), and all three gave favorable results.